Polar Orbiting Satellite Direct Broadcast Processing Package for Regional Users – A Value Added &Unique System in Support of NPP/NPOESS Mission

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Space Science and Engineering Center (SSEC)
University of Wisconsin-Madison (UW-Madison)

2004 Satellite Direct Readout Conference

Miami, 8 December 2004

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University of Wisconsin-Madison
SSEC Direct Broadcast X-band Groundstation

SeaSpace 4.4 meter antenna; operational since Jan. 2001.

Receives Terra, Aqua, Oceansat, ERS-2, Radarsat, ADEOS-II.

Line of sight to the horizon in all directions.

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UW Direct Broadcast Processing Package Heritage

	ITPP	IAPP	IMAPP
Sensor /Data Type	HIRS/2 MSU AVHRR	HIRS/2 AMSU AVHRR	MODIS AIRS AMSU AMSR-E
Example Products	T/Q Sounding Cloud Height SST	T/Q Sounding Cloud Height SST	T/Q Sounding Cloud Mask Cloud Phase Cloud Height SST Others
S/C	TIROS-N to NOAA 14	NOAA 15-17	EOS Terra & Aqua
Operation Period	1983 – Current	1998 – Current	2001 – Current

ITPP- International TOVS Processing Package

IAPP-International ATOVS Processing Package

IMAPP-International MODIS/AIRS Processing Package

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International MODIS & AIRS Processing Package - IMAPP

IMAPP – Key s/w package for data calibration, navigation (geo-location), and products generation

IMAPP Level 1 and Level 2 software have been ported to and tested on a variety of UNIX/PC platforms, including:

SGI MIPS, IRIX 6.5

Sun Ultra, SunOS 5.7

IBM RS/6000, AIX 4.3

HP PA-RISC, HP-UX B.10.20

Intel Pentium, Linux 2.2.12-20

Intel Pentium, Solarisx86 2.5.1

IMAPP is designed with the end user in mind; it must be easy to use and install. These requirements were used in its development:

- IMAPP must be portable to a wide range of UNIX/PC platforms.
- Minimize the number of required toolkits.
- Science data products must work using both DAAC L1B and direct broadcast IMAPP L1B as inputs.
- All ancillary data sets must be easily accessible.
- Downlinked spacecraft ephemeris and attitude data may be used for real-time geolocation.
- The software must create products that are similar to those produced at the Goddard Space Flight Center (GSFC) DAAC.
- The code must be efficient.

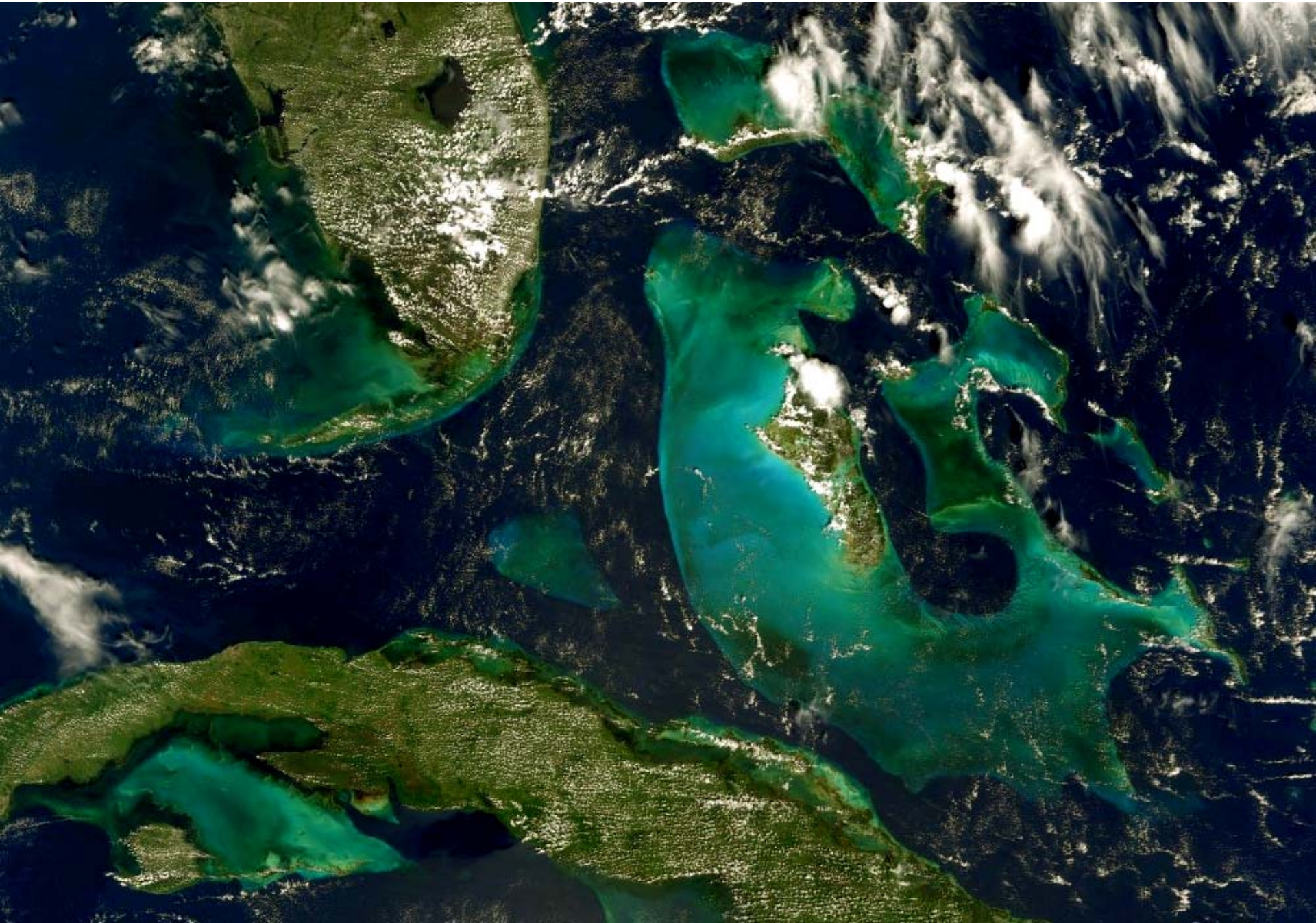
Partial List of IMAPP Users

IMAPP User	Purpose
CSIR Satellite Application Centre Hartbeeshoek - South Africa	IMAPP MODIS Level 1B used for generation of surface reflectance, NDVI , BRDF, LST, SST
US Forest Service, Missoula, Montana, USA	IMAPP MODIS Level 1B and eventually aerosol product for fire monitoring
Center for Space and Remote Sensing Research, National Central University, Taiwan, ROC	IMAPP MODIS Level 1 and Level 2 products used for studying the atmospheric temperature, ozonosphere, sea surface temperature, chlorophyl, ocean color, vegetation indices and forest fires
National Institute for Space Research – INPE, Sao Paulo, Brazil.	IMAPP MODIS Level 1B used to serve INPE/CPTEC, IBAMA and other Governmental institutions.
Institute of Geography and Resources Research, Chinese Academy of Science	IMAPP MODIS Level 1 and Level 2 products
Kongsburg Satellite Services, Tromso, Norway	IMAPP MODIS Level 1 and Level 2 products distributed with ground stations world wide for a variety of environmental applications
ScanEx Research and Development Center, Moscow, Russia	IMAPP MODIS Level 1, and Level 2 cloud mask and SST used for a wide range of land and sea surface monitoring tasks
Plymouth Marine Laboratory, Plymouth, United Kingdom	IMAPP MODIS Level 1 and Level 2 cloud product, cloud mask, and atmospheric profiles products. Used as a deliverable for the EC funded CLOUDMAP2 project which finished in January 2004
EROS Data Center, Sioux Falls, South Dakota, USA	IMAPP MODIS Level 1 products are reprojected for users on the AmericaView project, a National and State Partnership to Enable Remote Sensing Education, Training, and Applications
Australian Centre for Remote Sensing, Alice Springs, Canberra and Hobart Australia.	IMAPP MODIS Level 1 and, in test right now, Level 2 cloud mask and cloud properties. These products are being utilized in various environmental applications

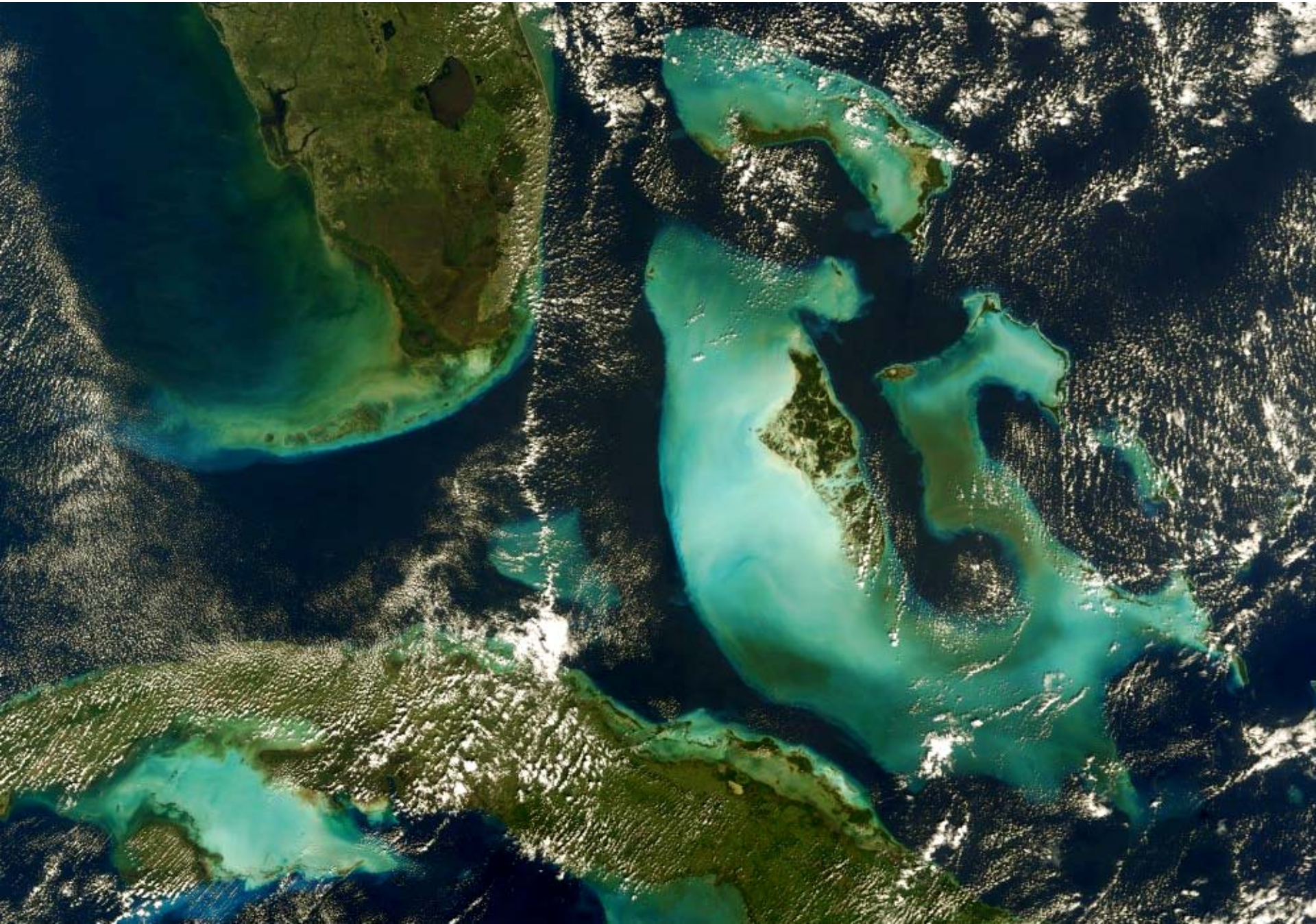
Other Known IMAPP Users

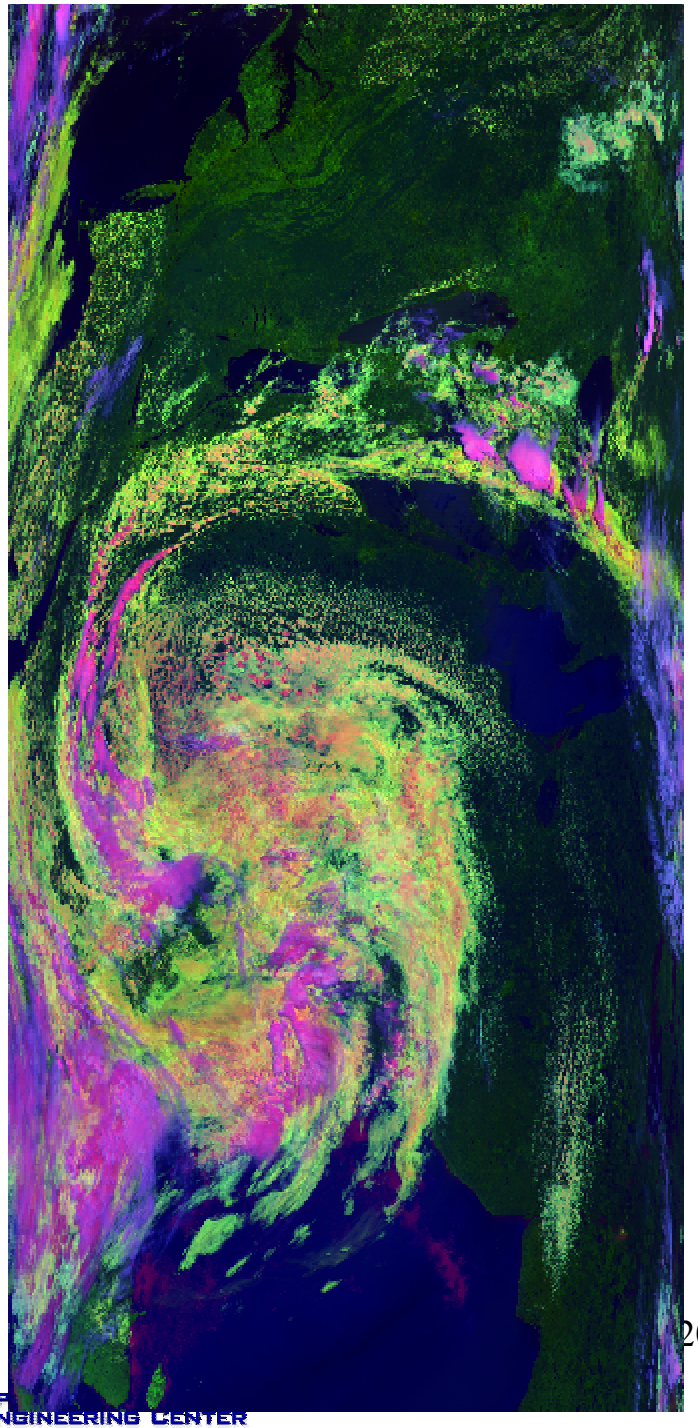
- **Naval Research Laboratory, Monterey, California, USA - Utilizes IMAPP products for real time forecasting and mission support.**
- **Satellite Services Division, NOAA/NESDIS, USA.**
- **Atmospheric and Environmental Research, Inc, Lexington Massachusetts, USA.**
- **Upper Midwest Aerospace Consortium, University of North Dakota, USA.**
- **National Center for Environmental Prediction (NCEP), NOAA, USA.**
- **MODIS Snow and Sea Ice Global Mapping Project, NASA/GSFC, USA.**

2001/10/05 1610: Bahamas and Cuba



2001/11/06 1610: Bahamas and Cuba





Aqua
Color
Composite

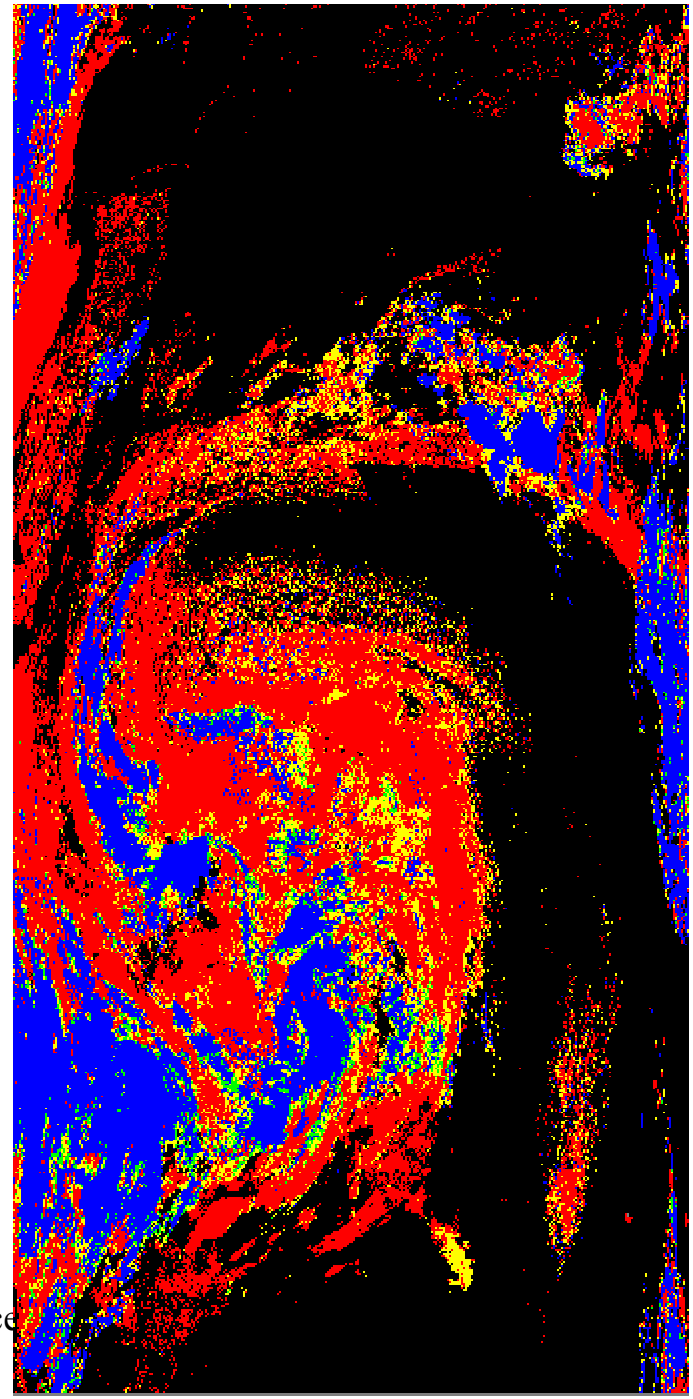
Red: B1 (.645)

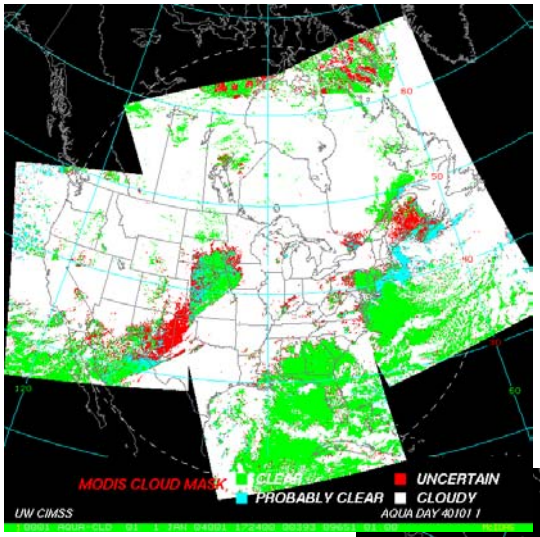
Green: B6 (1.64)

Blue: B31 (11.)

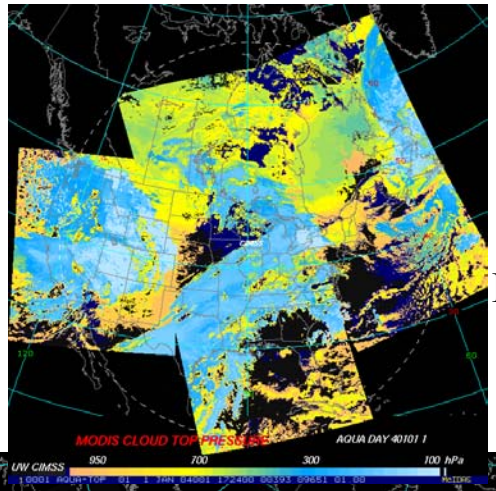
Cloud Phase
(Day time Alog.)

- *Ice*
- *Water*
- *Mixed*
- *Uncertain*
- *Clear*
- *No Retrieval*

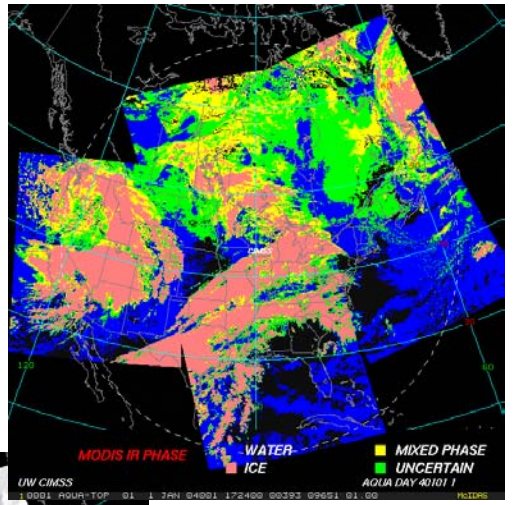




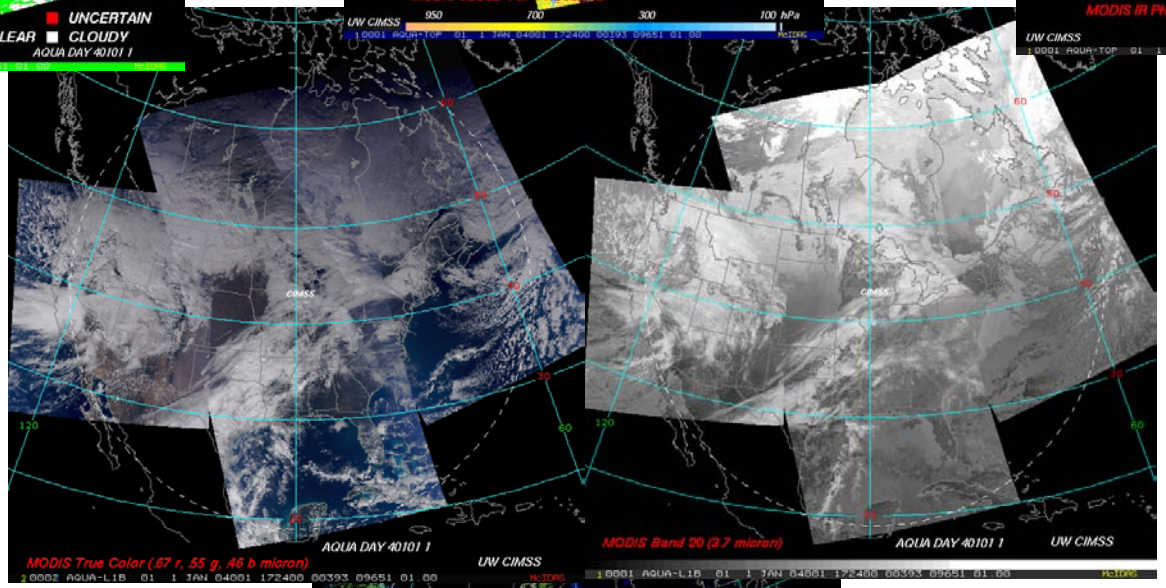
Cloud Mask



Cloud Top Pressure

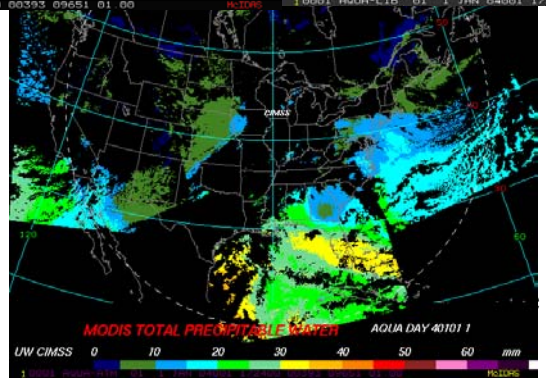


Cloud Phase



Color Composite

Spectral Image (B20)



Total Precipitable Water

Aqua MODIS

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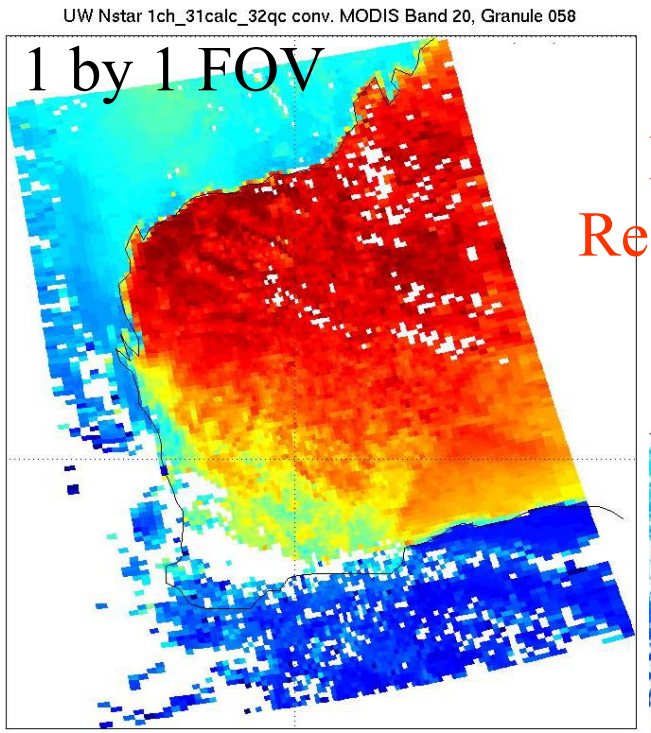
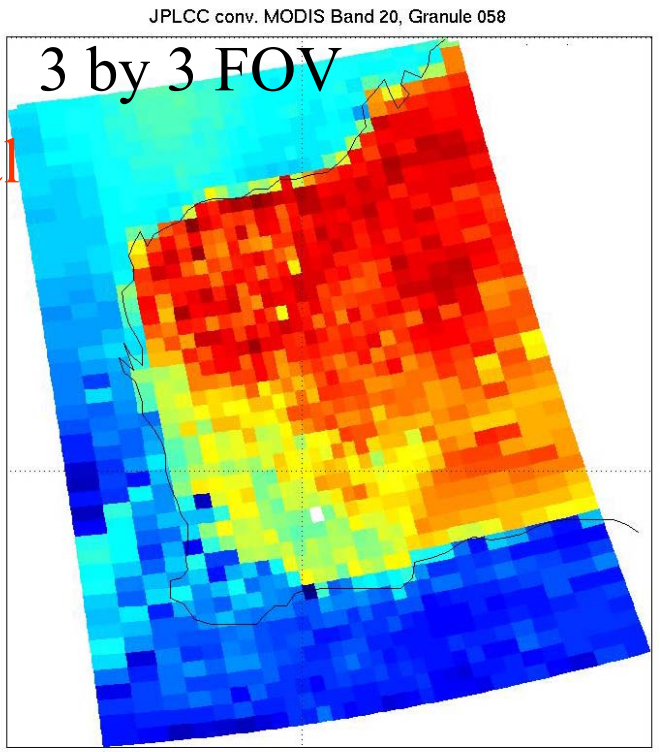
AIRS Operational and Direct Broadcast "Cloud Clearing" Brightness Temperature Comparison

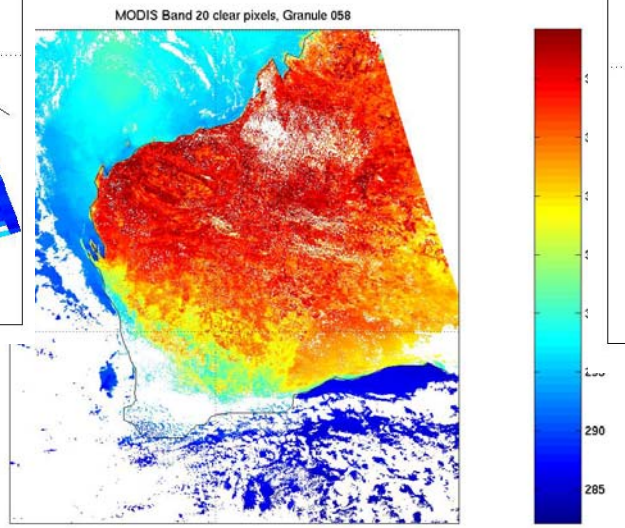
MODIS Band 20 (3.7 Micron)



DB Regional ⟷ Operational Global



AIRS DB (14km x 14km)



MODIS (1km x 1km @nadir)

AIRS Operational (42km x 42 km)

***AIRS cloud clearing Version 3.5.0**

%With failed quality control data

6 Sep 2002 focus day Granule 58 (Partial Land Day)

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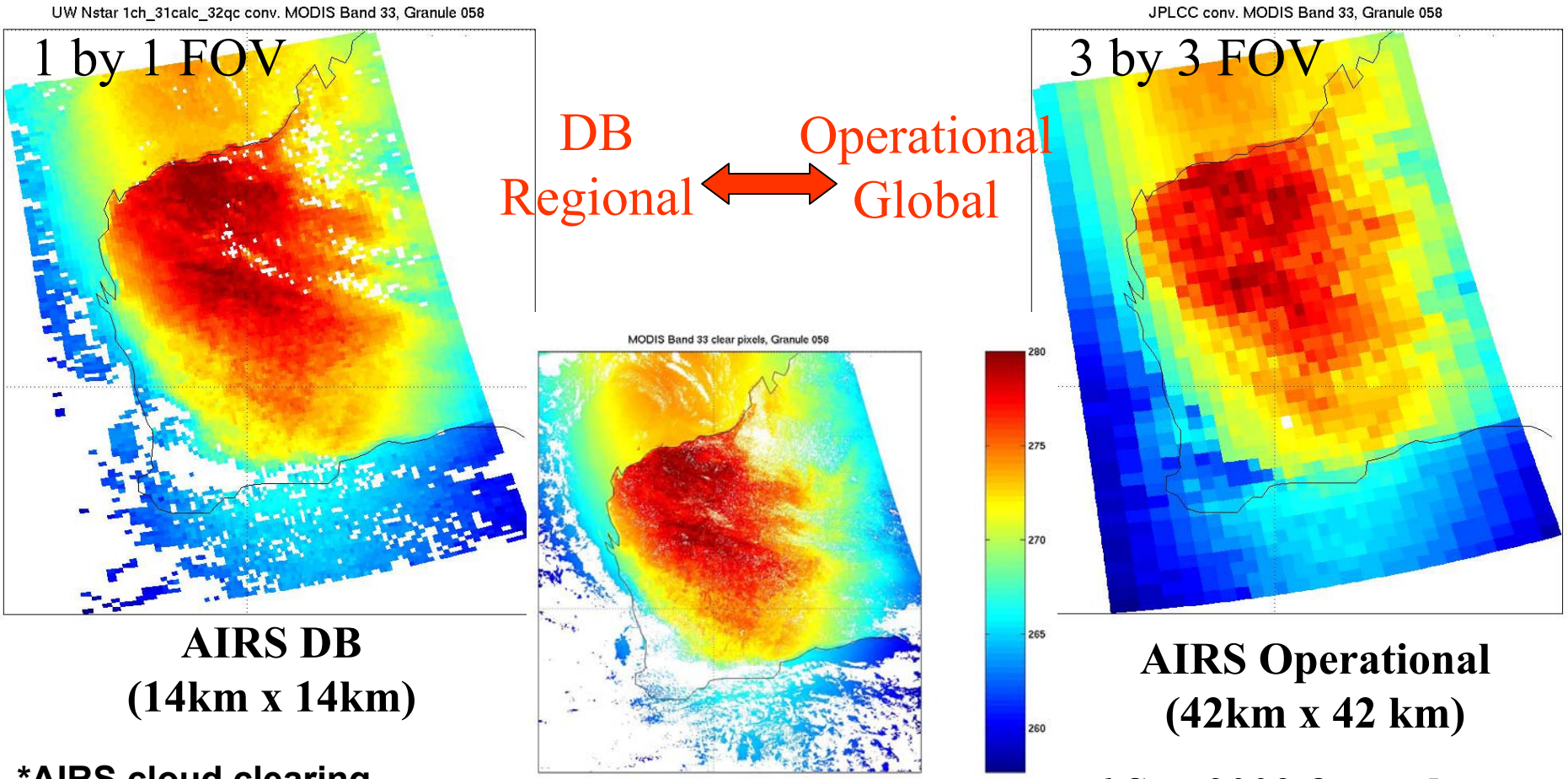
AIRS Operational and Direct Broadcast "Cloud Clearing" Brightness Temperature Comparison

MODIS Band 33 (13.3 Micron)



AIRS DB (14km x 14km)

AIRS Operational (42km x 42 km)

MODIS (1km x 1km @nadir)

6 Sep 2002 focus day Granule 58 (Partial Land Day)

***AIRS cloud clearing Version 3.5.0.0**

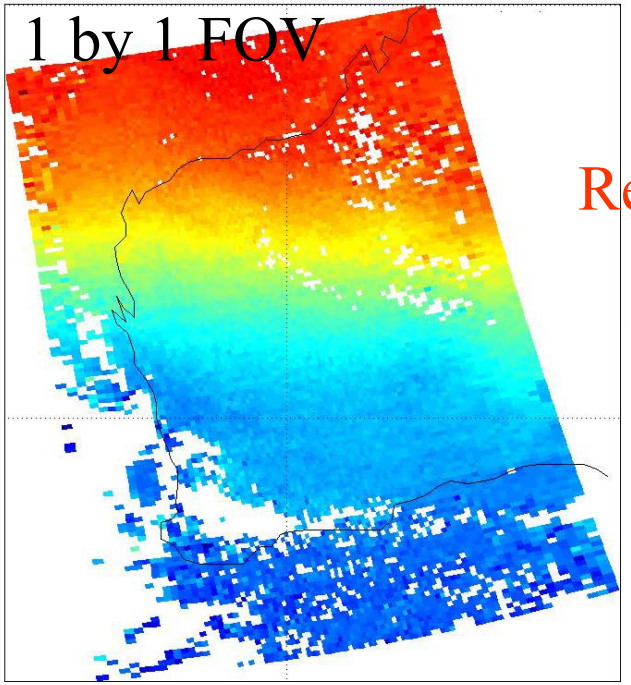
%With failed quality control data

SPACE SCIENCE AND ENGINEERING CENTER

AIRS Operational and Direct Broadcast "Cloud Clearing" Retrieval Comparison

500 mb Temperature

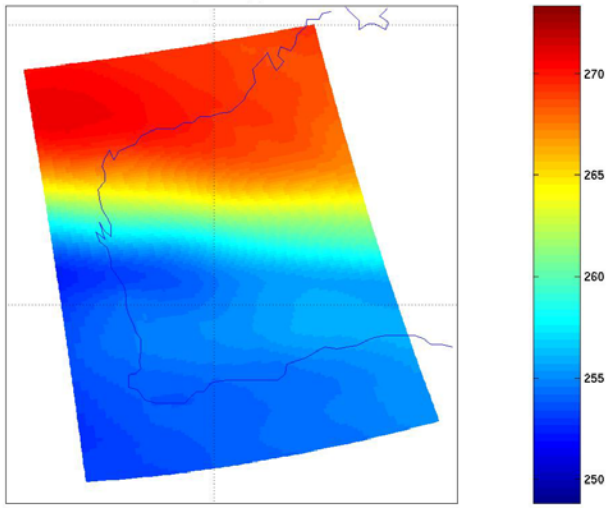
AIRS.2002.09.06.058.atm_prof_rtv_npc30_1ch_31calc_32qc.img
retrived temperture (K) at 496.63 mbar



AIRS DB (14km x 14km)

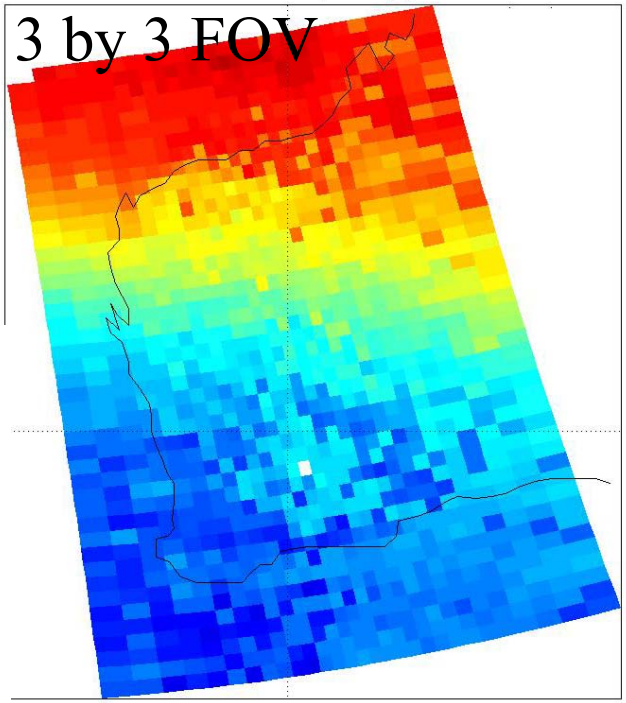
DB Regional ⟷ Operational Global

ECMWF.2002.09.06.T06Z.uad_GrbF00.A02292062954
ECMWF temperature (K) at 496.63 mbar



ECMWF (110km x 110km)

AIRS.2002.09.06.058.L2.RetStd.v3.5.0.0.Test3_5_0.T04056195913.hdf
Granule058 retrived temperature (K) at 500 mbar



AIRS Operational (42km x 42 km)

6 Sep 2002 focus day Granule 58 (Partial Land Day)

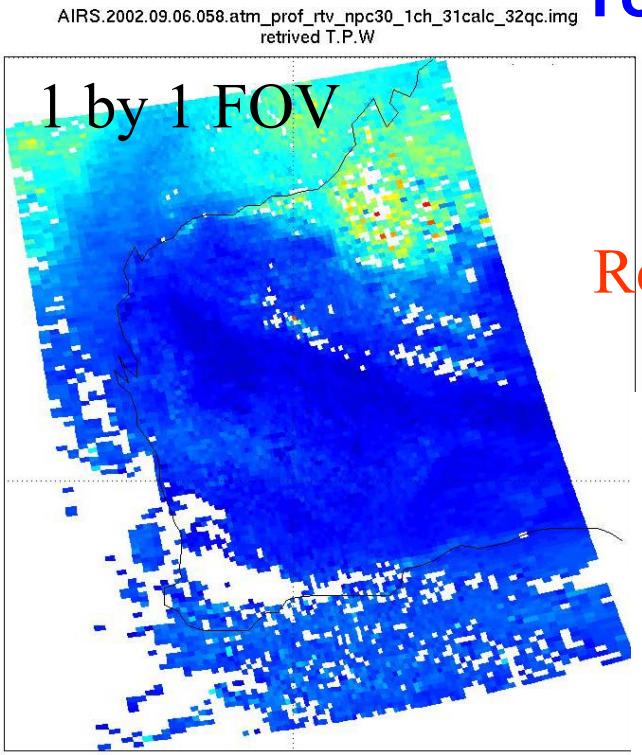
***AIRS cloud clearing Version 3.5.0.0**

%With failed quality control data

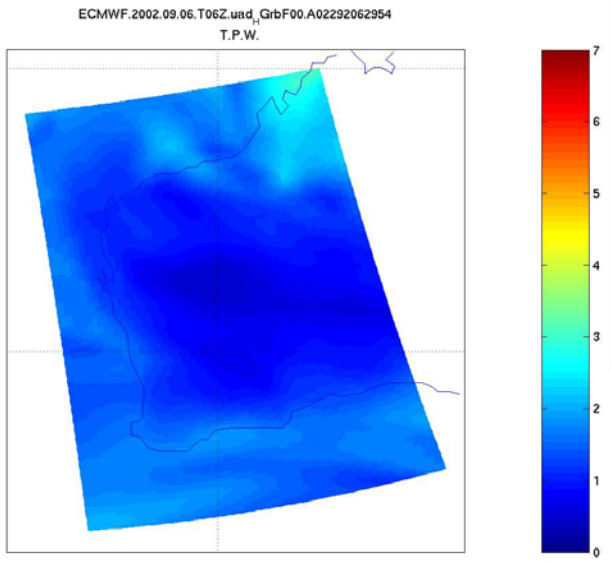
SPACE SCIENCE AND ENGINEERING CENTER

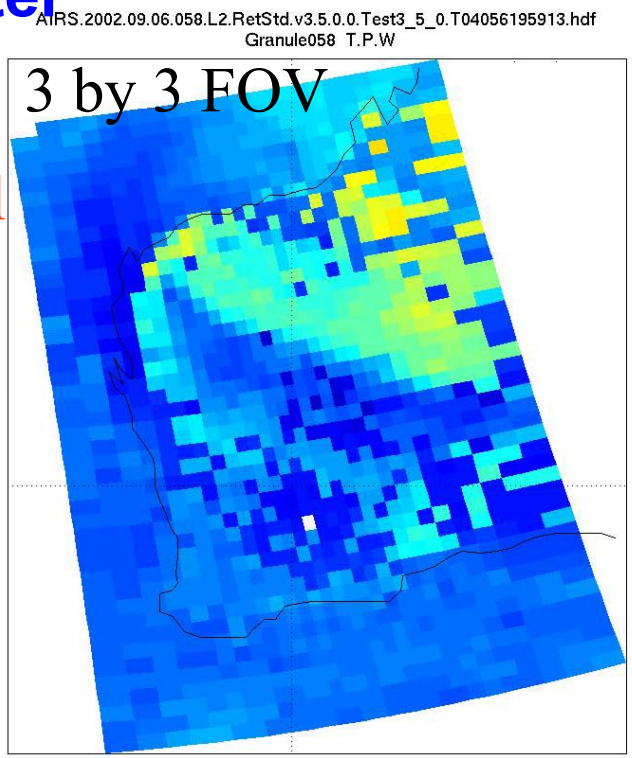
AIRS Operational and Direct Broadcast "Cloud Clearing" Retrieval Comparison

Total Precipitable Water



DB Regional ⟷ Operational Global





AIRS DB (14km x 14km)

ECMWF (110km x 110km)

AIRS Operational (42km x 42 km)

***AIRS cloud clearing Version 3.5.0.0**

%With failed quality control data

6 Sep 2002 focus day Granule 58 (Partial Land Day)

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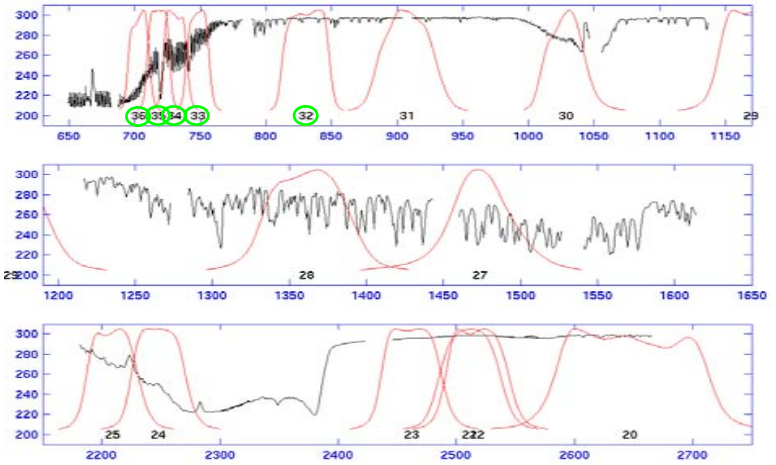
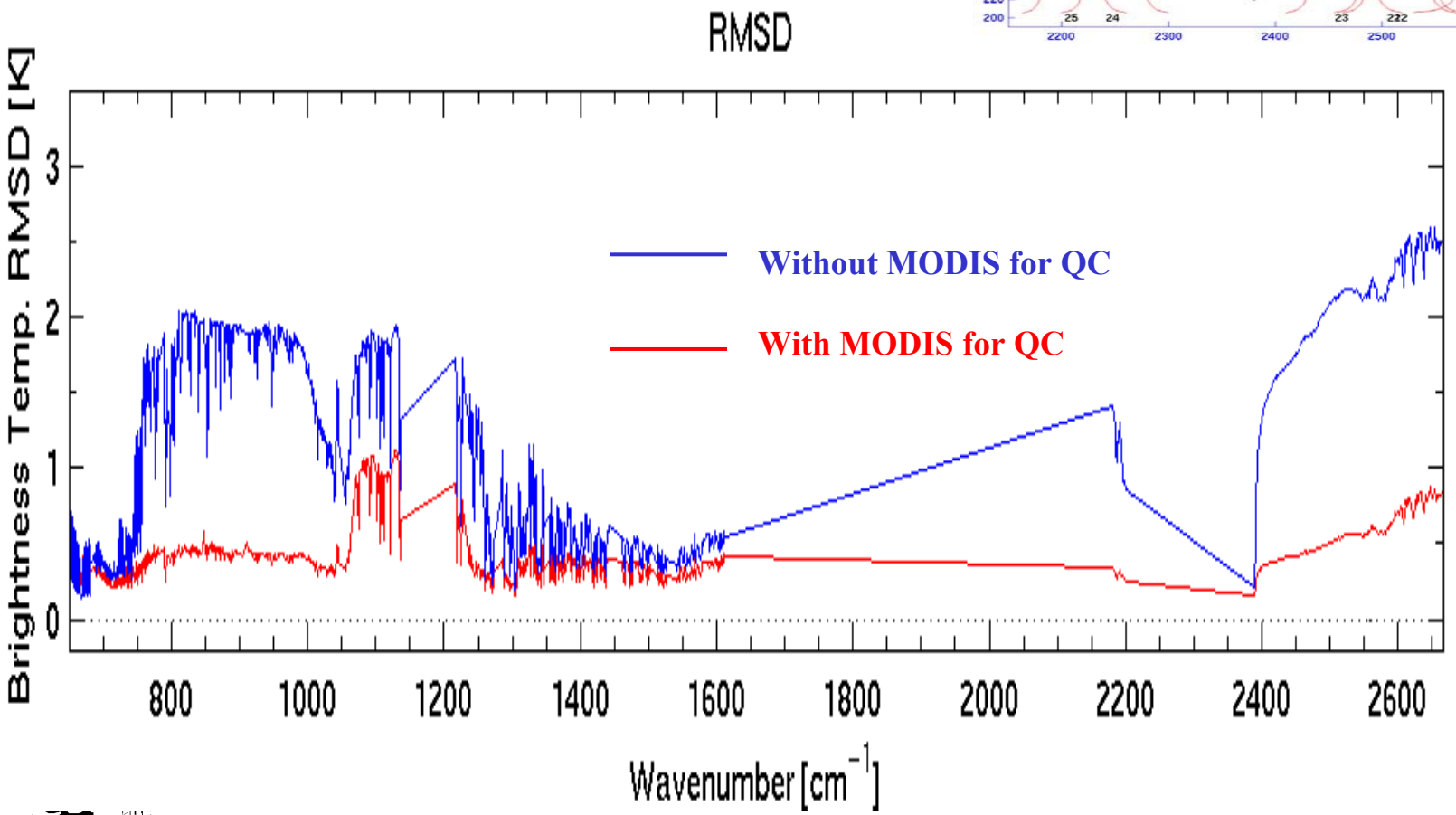
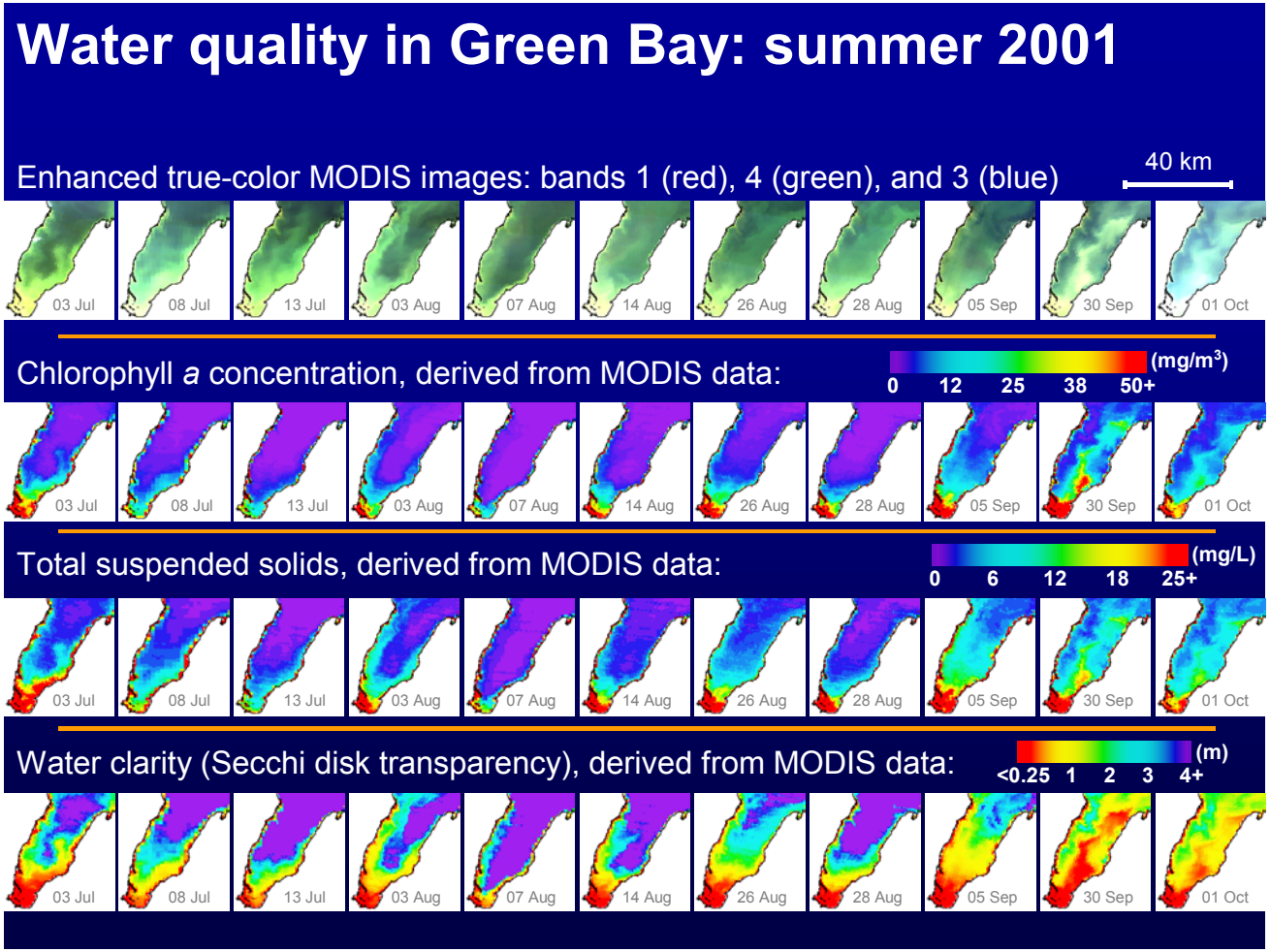
Unique Regional Direct Broadcast Synergistic Imaging/Sounding Applications





IMAPP EDR/Level 2 Adopted, Developed and Underdeveloped to Date

IMAPP Level 2 Product Summary		
MODIS	**AIRS/AMSU/HSB**	**AMSR-E**
Aerosol Optical Depth	Cloud Detection	Soil Moisture
Surface Reflectance	Cloud Properties	Precipitation
Snow Detection	Cloud Height/Emissivity	
Sea Ice Detection	Cloud Liquid Water	
Scene Classification (Clouds and Land Surface)	AMSU Precipitation Estimate	
Cloud Particle Size	Atmospheric Sounding Profile (AIRS science team algorithm)	
Cloud Optical Thickness	Single Clear AIRS FOV Atmospheric Sounding Profile	
Ocean Color		
Suspended Sediment		
Atmospheric Sounding		
Total Perceptible Water		
MODIS/AIRS Collocation		
MODIS/AIRS Cloud Clearing		
MODIS/AIRS Cloud Properties		
MODIS/AIRS Visualization Tool (hydra)		
IMAPP Remote Sensing Workshops		
Real-time Air Quality Monitoring System		
Under Development Under Beta Testing Processing Algorithm Released		



Example of Regional direct broadcast MODIS IMAPP application. MODIS Level 1B data is used to monitor water quality over Green Bay, Wisconsin. Courtesy of Jonathan W. Chipman, UW-Madison ERSC.

SPORT Short-term Prediction Research and Transition Center

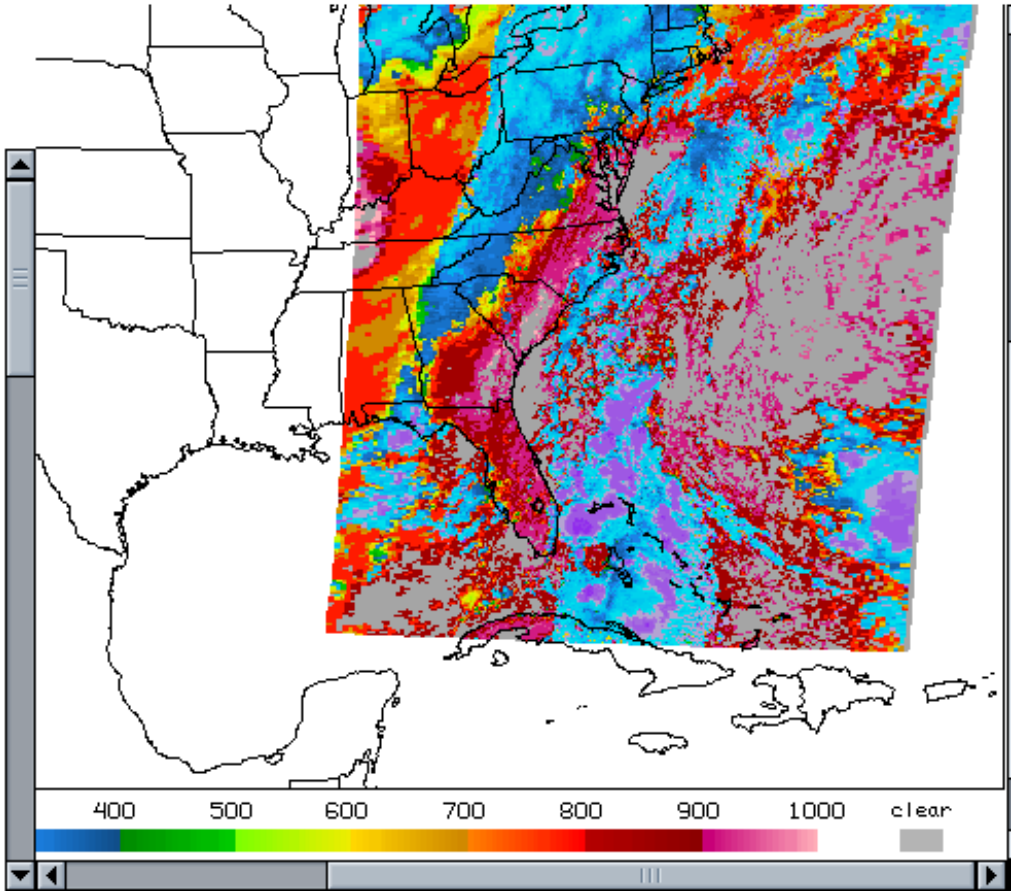
NASA

MODIS Terra: Imagery Products Tracks Aqua: Imagery Products Tracks Back to Products and Imagery

Select a day:
2004 Jul 27 15:44

Terra MODIS Products
2004 Jul 27 15:44 UTC

- Cloud Top Pressure
  - Conus
  - Regional
- Cloud Phase Image
  - Conus
  - Regional
- Cloud Mask
  - Conus
  - Regional
- Water Vapor
  - Conus
  - Regional



Example of the MODIS cloud top pressure IMAPP product as displayed on the SPORT page from the 15:44 UTC overpass on 27 July 2004.

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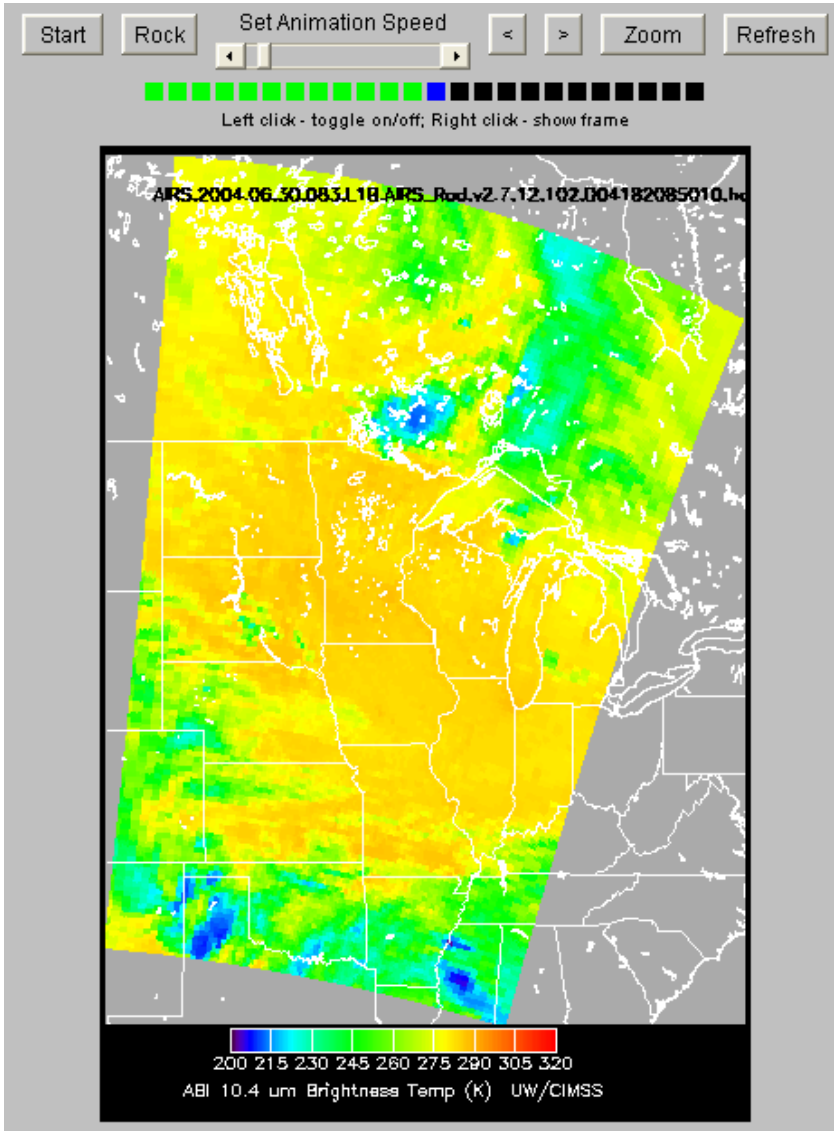
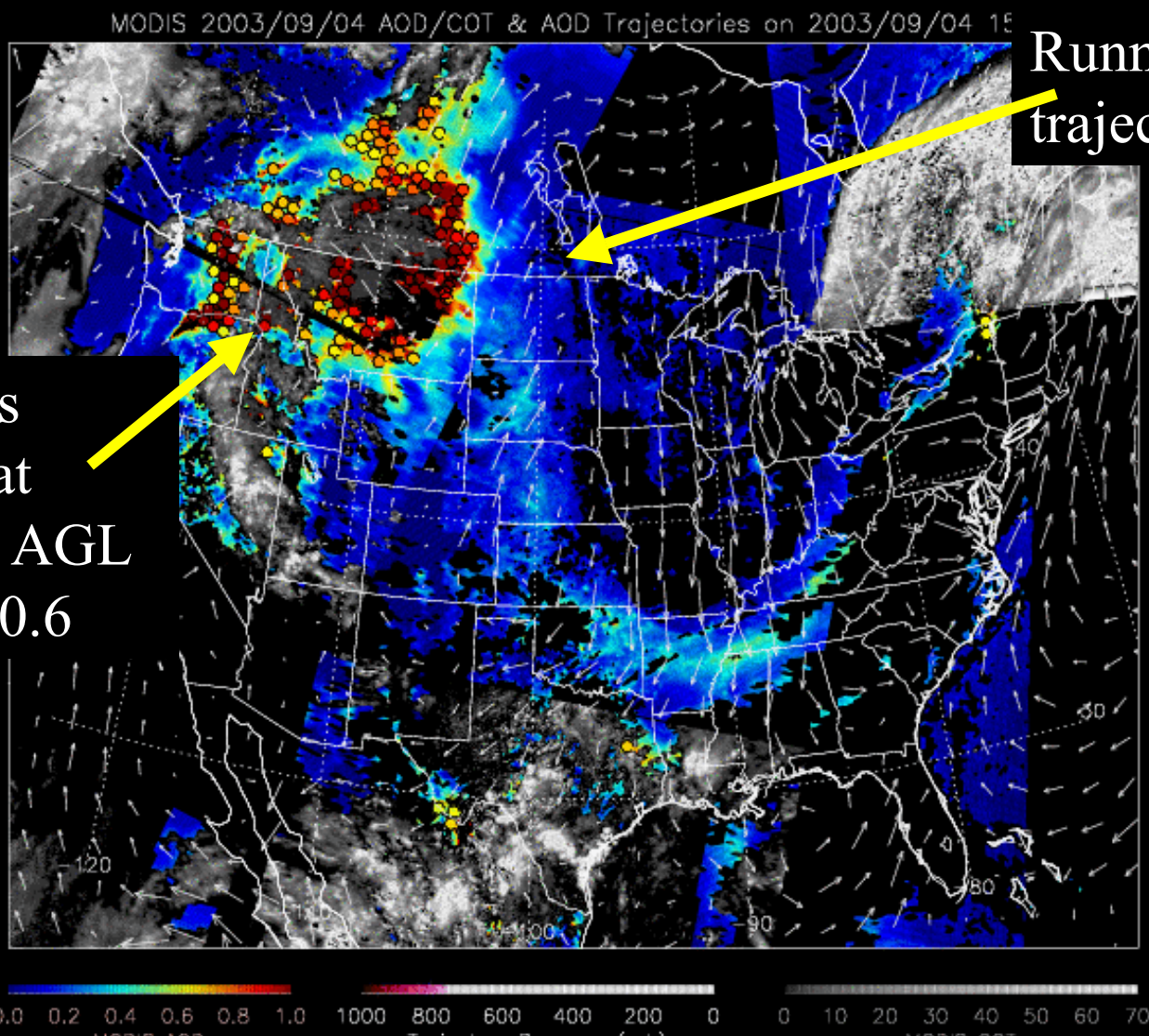
Advanced Satellite Products Branch ORA/NESDIS, NOAA

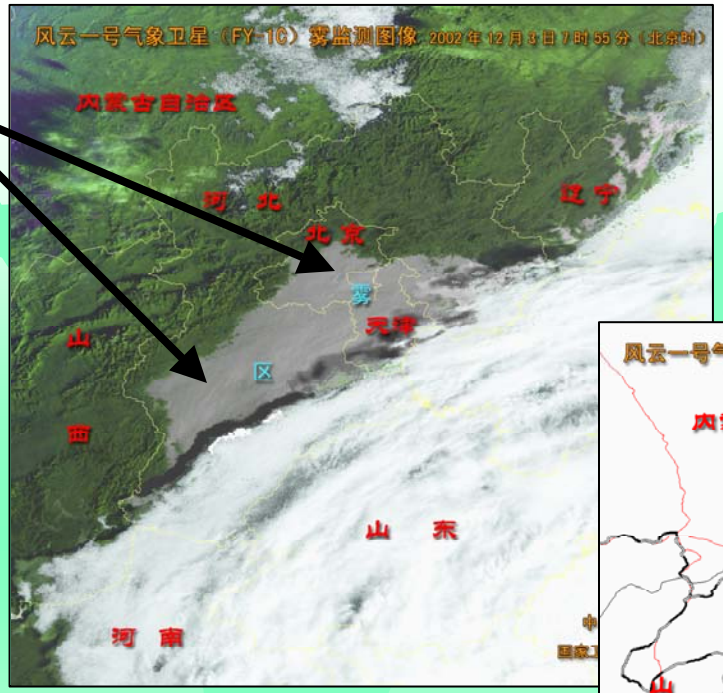


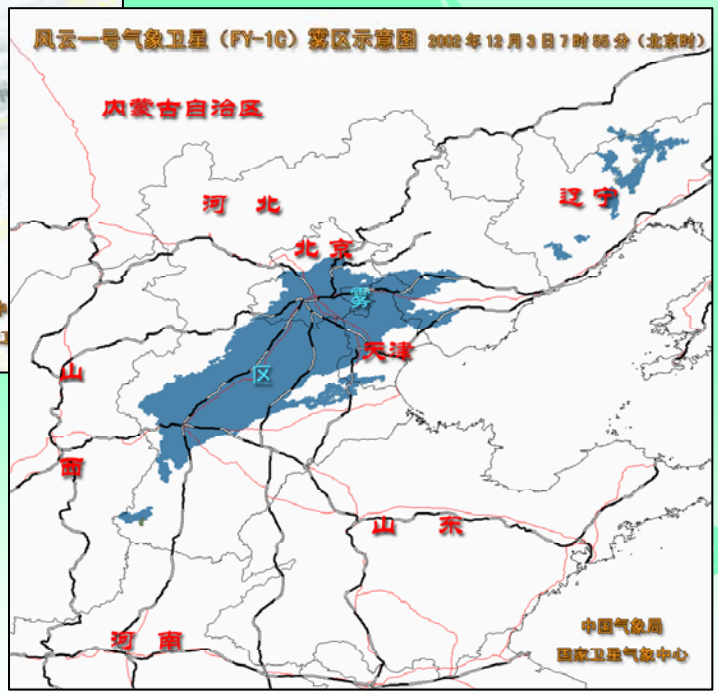
.**Simulated ABI image generated using IMAPP AIRS radiances from 6 June 2004**

MODIS DB Aerosol Optical Depth 48 hour Air Parcel Forecast Trajectories (04 September 2003)



Area of Fog





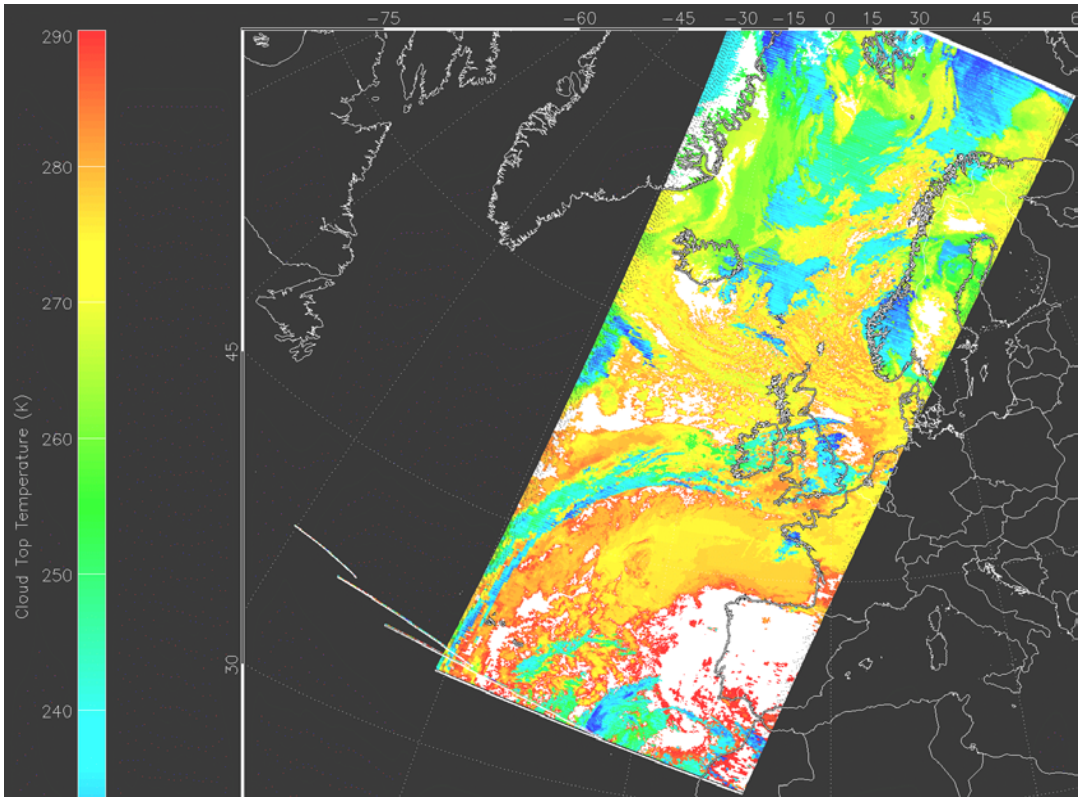
Fog around Beijing highway with overlay of GIS to assist traffic. (Dec 3,2003).

MODIS true color image of a fog event near Beijing, China (upper left) and the associated fog region overlaid on a road map (bottom right). The MODIS image was produced using IMAPP software. Courtesy of Dr. Wenjian Zhang.

IMAPP MOD06 cloud top temperature created by the Plymouth Naval Laboratory of UK as part of the EU CLOUDMAP2 program

Cloud Top Temperature Plymouth Marine Lab, UK

10 October 2003 11:57 UTC



IMAPP MOD06 cloud top temperature product created by the Plymouth Naval Laboratory, UK.

Example of ScanEx company in Russia using the MODIS IMAPP cloud mask, 15 October 2004, as a search and sub-setting tool

EOStation.ScanEx.ru

EOStation
Schedules
>MODIS data
Product calendar
MRDS
Search&Browse
Sample files
Custom service
Under the hood
Software
Image gallery
Contact us

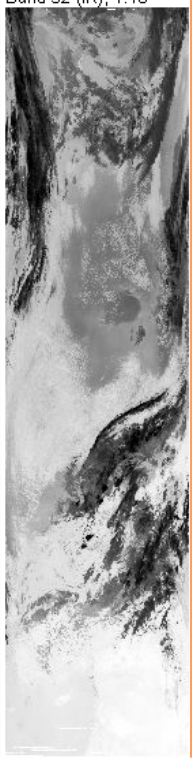
Login to your private area:
Password:
Login

MODIS Data >> Single Pass Browse [AM0409050814]

Pass ID: AM0409050814
Satellite: Terra
Start time: 2004-09-05 08:14 UTC

RGB: 1-4-3, 1:10

Band 32 (IR), 1:10



Product files currently available for this pass that may be downloaded or requested on CDs.
Use links on file names to download the files. If file names are not marked as a link then the file is missing or you have no permission to access corresponding data type.

File	Size	Notes
TCB1.AM0409050814.ecw	1823 kB	True color (1-4-3) image, ECW compressed, 1km
-	-	MODIS Level-0(raw) data
-	-	MOD01, unpacked image data
-	-	MOD03, geolocation data
-	-	MOD021KM, geolocated calibrated radiances (1km)
-	-	MOD02HKM, geolocated calibrated radiances (500m)
-	-	MOD021KM, geolocated calibrated radiances (250m)
-	-	MOD021OBC, onboard calibrator data
MOD35.AM0409050814.cl.gif	623 kB	1km MODIS cloud mask. GIF image, levels of free sky confidence
MOD14_AM0409050814.zip	26 MB	MOD14, MODIS fire mask (ZIP compressed)
MOD14shp_AM0409050814.zip	13 kB	MODIS fire points vector map (ESRI SHP, ZIP compressed)

> 80 Sites

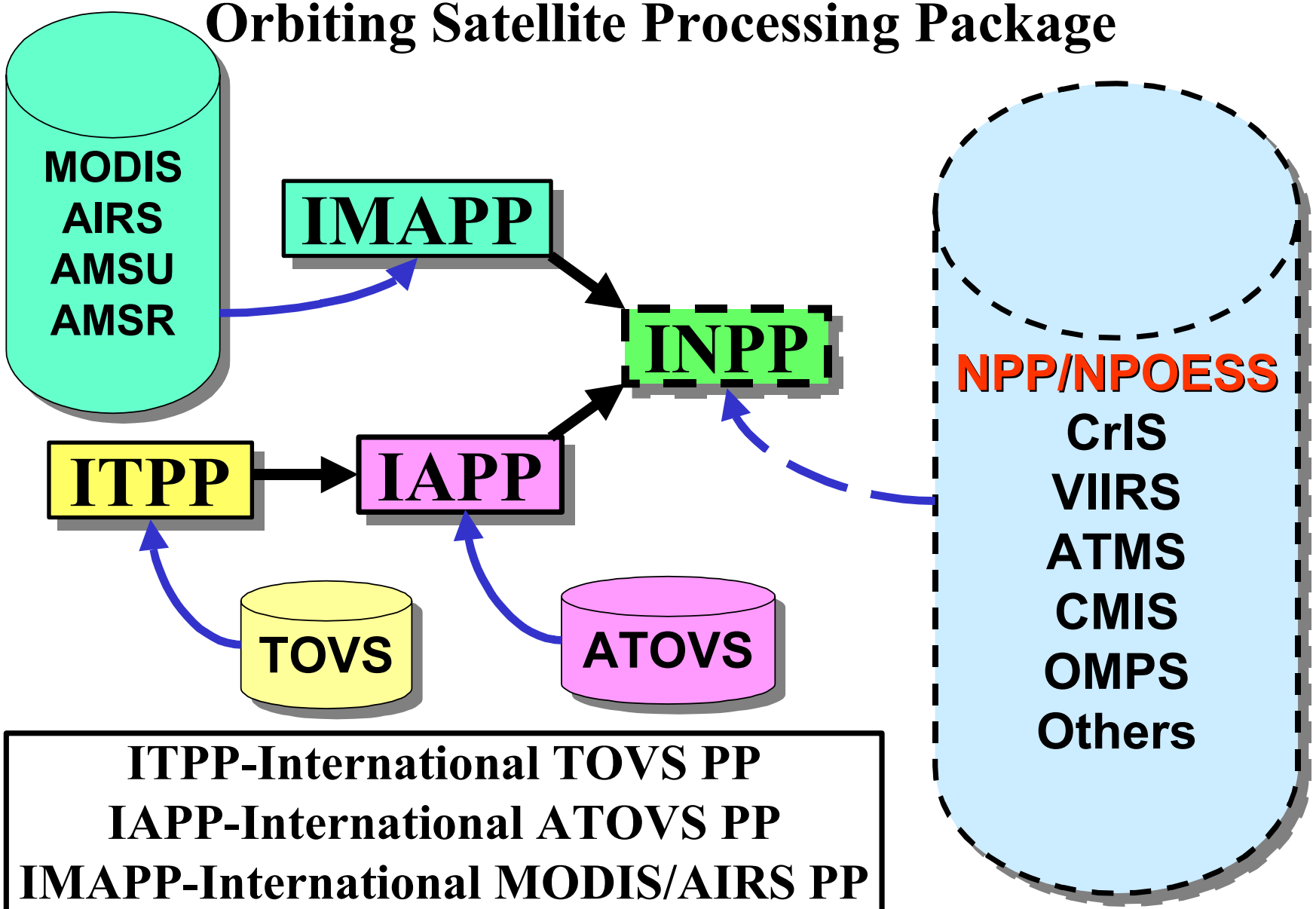
EOS Direct Broadcast Sites Worldwide – Updated Oct. 8, 2003

Countries Using IMAPP

- United States
- United Kingdom
- Germany
- Italy
- Norway
- Japan
- China
- Russia
- South Korea
- Singapore
- Thailand
- Vietnam
- Brazil
- South Africa
- Australia
- Mexico
- Taiwan

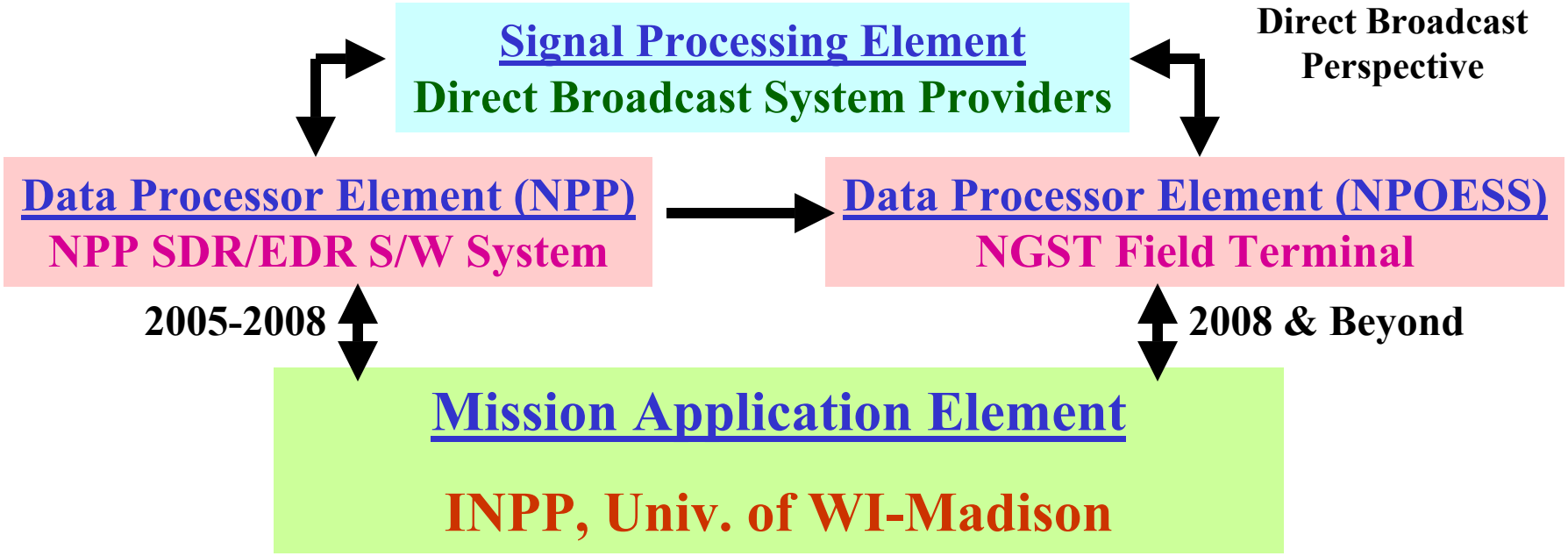
http://cimss.ssec.wisc.edu/~gumley/IMAPP/

UW Past, Current and Future International Polar Orbiting Satellite Processing Package



ITPP-International TOVS PP
IAPP-International ATOVS PP
IMAPP-International MODIS/AIRS PP
INPP-International NPP/NPOESS PP

Role of UW INPP in NPP/NPOESS Mission



To Provide Value Added Services of

1. Support DOD/Civil N.A. Regional Users
2. Value Added Mission Application Products Generation
   - Regional Optimized/Unique Products
   - Specialty/Synergistic Products
3. Continuous Calibration/Validation & Evaluation Support
4. NPP SDR/EDR & NPOESS Field Terminal P/P Support
5. Engage Global DB Community in NPP/NPOESS Mission

CIMSS/SSEC has developed and supported direct Broadcast processing packages for the NOAA polar orbiter platforms since 1983 and EOS platforms since 2001.

UW-Madison is uniquely qualify to become an integrated member of NPP/NPOESS direct broadcast team, …..
to support national/international direct broadcast users and to customize and facilitate optimal use of NPP/NPOESS SDRs and EDRs

IMAPP Web Site
http://cimss.ssec.wisc.edu/~gumley/IMAPP/

IAPP Web Site

http://cimss.ssec.wisc.edu/opsats/polar/iapp/IAPP.html

International TOVS Working Group Web Site

http://cimss.ssec.wisc.edu/itwg/

International TOVS Study Conference

As John Cunningham Said this morning:

The data are up there … Its up to us to make it happen

"INPP is an unique way to achieve it!!!"

NOAA/EOS Direct Broadcast Processing Package Contacts:

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Kathy Strabala – kathys@ssec.wisc.edu

Tom Achtor – toma@ssec.wisc.edu